



## LAPAROSCOPIC MANAGEMENT OF COMMON BILE DUCT STONES

## Surgery

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## ABSTRACT

**Introduction:** Common Bile Duct stones (CBD) are found in approximately 16% of the patients undergoing Laparoscopic cholecystectomy (LC). Till recently, the gold standard for treating CBD stones was endoscopic removal, if that failed, then open surgery. However, in the laparoscopic era, the best treatment for CBD stones is a matter of debate and it continues to evolve. The objective of the present study is to determine that laparoscopic CBD exploration (LCBDE) is a safe, feasible and single-stage option for the management of CBD stones.

**Materials and Methods:** Out of the 2900 laparoscopic cholecystectomies we did selective intraoperative cholangiogram in 262 patients who were suspected to have CBD stones based on deranged liver function tests, dilated CBD with or without CBD stone on sonography or having the history of recent jaundice/pancreatitis. If CBD stone was found, either a transcystic or transcholedochal exploration was done depending on the size, site, number of stones and CBD diameter. Choledochotomy was closed over a t-tube in the majority of the patients. Primary closure of CBD was done in few patients and in one patient we placed an antegrade stent and in another we placed endoscopic stent into the CBD laparoscopically which was removed after four weeks.

**Results:** Till date we have performed LCBDE in 64 patients. Transcystic exploration was done in 14 patients and transcholedochal exploration was done in 46 cases out of which 2 patients had minor biliary leak which settled on conservative treatment in 2-3 days. Four patients required conversion to open surgery as there were multiple stones. We did not have any major complication and on 6 months follow-up in 76% patients, none was found to have residual stone.

**Conclusion:** The treatment of CBD stones depends on the resources available, technical limitations and the surgeon's expertise. Laparoscopic CBD exploration is a safe, feasible and single-stage option for the management of CBD stones.

## KEYWORDS

## INTRODUCTION

Common bile duct (CBD) stones are found in approximately 10-16% of the patients undergoing Laparoscopic cholecystectomy (LC). Until recently it was generally agreed that if stones are detected in CBD preoperatively, it seemed appropriate to remove them prior to LC by Endoscopic Sphincterotomy (ES). If CBD stone could not be extracted by ES, then CBD stone was extracted by open CBD exploration.

However, in the present laparoscopic era, the best treatment for patients with choledocholithiasis is a matter of debate and the management of choledocholithiasis continues to evolve. If the stones are found by intraoperative cholangiography during LC, the surgeon may either do the LC and refer the patient to ES postoperatively, or he may convert to open CBD exploration or in the current times he may do LCBDE.

The advent of ERCP and ES dramatically changed the management of CBD stones. ERCP and ES is a quick and often painless procedure, successful in >90% of the patients. However, there are a few adverse effects of the procedure like pancreatitis, bleeding, failure to clear duct, cholangitis, recurrent stone formation and possibility of malignancy in the long run. The second revolution in the management of the bile duct stones came with advancement in the laparoscopic surgery.

The objective of the present study is to determine that laparoscopic CBD exploration is a safe, feasible and single-stage option for the management of CBD stones.

## MATERIALS AND METHODS

A retrospective analysis was done at Surgery Department of IGIMS, Patna, Bihar on the patients undergoing LC we have performed 2900 LCs for symptomatic cholelithiasis in our department. Thorough history and clinical examination was done and the patient was investigated in the form of routine blood tests, liver function test including amylase and abdominal sonography. If there was suspicion of CBD stone, on the basis of predictors of CBD stone as shown in Table 1, patients were subjected to selective Intraoperative cholangiogram (IOC). We have not used any scoring system for predicting the CBD stone, and did the IOC even if one of the factors was positive.

Patients with choledocholithiasis associated with mild gallstone pancreatitis were operated if the Ranson score was 3 or less. If the Ranson's score was >3, surgery was postponed till the acute bout of pancreatitis subsided.

Patients who were unfit for operation or those with severe pancreatitis/cholangitis and those who were diagnosed to have CBD stone with bile duct diameter <6 mm were subjected to ERCP and were excluded from the present study.

Patients who had previous upper abdominal surgery or previous ERCP were also excluded from the present study.

## Table 1: Predictors of CBD stone

## 1. History / Clinical

- Jaundice within 6 months
- Pancreatitis within 6 months

## 2. Biochemical

- Bilirubin >10% of the normal at the higher side
- One or more liver function enzymes (Alkaline phosphatase, aspartate aminotransferase, alanine aminotransferase) >10% of the normal at the higher side
- Amylase >10% of the normal at the higher side

## 3. Ultrasound

- Dilated CBD >7 mm
- CBD stone

## Technique

The standard 4-port configuration for LC was used. A fifth port was made in between the right midclavicular and epigastric port just below the subcostal margin for inserting the choledochoscope.

The fundus of the gall bladder was retracted towards the right shoulder and the Hartmann's pouch was retracted downwards and outwards toward the right hip. Dissection began on to the neck of the gall bladder and continued proximally until the junction of gall bladder and the cystic duct was clearly defined. Dissection was continued proximally

on to the cystic duct until there was adequate length to perform cholangiogram. Then the cystic duct was milked towards the gall bladder to dislodge any cystic duct stone into the gall bladder. A clip was applied on the gall bladder side to prevent any back slippage of gallstone into the CBD and to prevent biliary spillage into the operative field.

IOC was done using a ureteric catheter (4-5 Fr) or an infant feeding tube (no 5-6), which was passed through the cystic duct (after making a small nick in the cystic duct) into the CBD. After the insertion of the catheter, a clip was applied snugly to prevent any back leakage of the contrast medium.

Digital C-arm fluoroscopy provided the real time imaging of the biliary tree. In cases where the cystic duct could not be cannulated, contrast was directly injected into the CBD through a lumbar puncture needle (Fr 24) percutaneously.

On cholangiogram, we looked for any filling defect- its size, site, number of bile duct stones, and free passage of contrast into the duodenum and for any anatomical variation of the biliary tree. We selected transcystic or transcholedochal approach to remove CBD stones depending on the factors shown in Table 2.

CBD stone were extracted with the help of Dormia basket/balloon catheter, irrigation/suctioning or by simply manipulating bile duct using blunt forceps. After retrieving the stones, the cystic duct stump was closed with clips or suture ligature and the gall bladder was removed in the usual manner.

Transcholedochal exploration was performed in the following manner. After opening up of the Calot's triangle, the anterior surface of the CBD was dissected carefully and choledochotomy was performed by a longitudinal incision with the help of endoscopic knife just below the insertion of the cystic duct into the bile duct. In the initial few cases we used stay suture before performing choledochotomy but later we incised bile duct longitudinally without any stay sutures. The stones were retrieved by spontaneous evacuation while incising the bile duct, blunt instrumental pressure with atraumatic forceps, Dormia basket, Fogarty balloon catheter or irrigation and suction.

**Table 2: Factors influencing approach**

Factor	Transcystic approach	Transcholedochal
No. of stones	<3 CBD stones	>3 CBD stones
Size of stone	Stone size <5 mm	Stone size >5 mm
CBD dilatation	CBD dilatation <1 cm	CBD dilatation >1 cm
Location of	Distal CBD stone	Proximal bile duct

Stones stoneFailed transcystic approach  
Completion cholangiography or choledochoscopy was performed to assess the completeness of the procedure. For the initial few case, we did not have the choledochoscope, so we used 5.5 Fr bronchoscope for the purpose. In the later part we performed cholangioscopy with the help of Choledochoscope (Fr 3.8, Olympus).

Choledochotomy was closed over a t-tube with continuous 3'0 vicryl suture. We did primary closure of CBD in a few cases after assessing the clearance of the CBD and in one case we placed a transcystic antegrade stent (using 5Fr ureteric catheter) which was brought out via cystic duct. The cystic duct was ligated twice with the antegrade stent in situ using 2'0 vicryl. In another case we placed a modified endobiliary stent (commercially available endobiliary stent, Fr 7 and 9 cm in length, with elimination of the proximal flap on the biliary side) into the distal CBD with distal flange through the papilla into the duodenum with the aid of choledochoscope.

After bile duct closure, cholecystectomy was performed in the usual manner. We placed an infrahepatic tube drain in all the cases which was usually removed on Day 3-4 as the output decreased below 30 ml/day.

**RESULTS**

Out of the 2900 patients undergoing LC, 262(9%) patients were subjected to selective IOC due to the suspicion of CBD stone based on the predictors of CBD stone as given in Table 1. Out of the 262 patients, 182 patients were female and 80 were male. The mean age group of the patient was 42 years (10-88 years).

Out of the 262 patients undergoing IOC, CBD stones were detected in

64 cases (24%). Out of 64 cases, 25 cases had a preoperative diagnosis of CBD stone (USG) and the rest were picked up on IOC. We removed CBD stones transcystically or by choledochotomy as shown in Table 3. Median duration of the procedure was 75 min (60-150 min). At the beginning of our experience the duration was longer, particularly in patients undergoing choledochotomy after failed transcystic extraction. The time taken for choledochotomy was 30-40 min more than that for the transcystic approach.

Post-operative course was similar to that of LC in the patients where transcystic exploration was done and the patient was discharged on post-operative Day (POD).

In patients who had undergone transcholedochal approach, t-tube was clamped on POD 4 and was removed on POD 7 without routine t-tube cholangiogram. Intra-abdominal drain was removed as the patients started oral diet and the drain output <30 ml/day. All the patients were discharged on POD 7 except 2 patients who had minor biliary leak which settled on conservative management in 2-3 days.

**Table 3: Our experience**

Laparoscopic Cholecystectomy	2900
Intraoperative Cholangiogram	262 (9%)
Detected to have CBD stone	64 (24%)
Transcystic approach	14
Transcholedochal approach	46
Choledochotomy closure over t tube	38
Primary CBD closure	06
Closure over an antegrade stent	01
Closure over an endobiliary stent	01

In patients where we put antegrade stent, we removed the stent on POD 4 and the patient was discharged on Day 5. We placed modified endobiliary stent laparoscopically into the CBD across the duodenum in one patient and the stent was removed after 4 weeks by endoscopy.

We did not have any mortality and the various complications which we encountered during laparoscopic CBD exploration are shown in Table 4.

We had to convert the laparoscopic procedure to conventional open CBD exploration in 4 patients. Out of these, we could not clear the bile duct in 3 patients due to multiple stone and in 1 patient there were severe adhesions present in the Calot's triangle and the bile duct could not be visualized properly. In 2 patients we had minor bile leak after removal of t-tube which settled on conservative treatment in 2-3 days. Minor wound infection in the form of erythema and serous collection at the port site occurred in 2 patients and 1 patient had small hematoma at the epigastric port site through which gall bladder was extracted conservatively. Mild pancreatitis developed in 2 patients which resolved on conservative treatment in 2-3 days.

Follow-up after 6 months were completed in 49 patients (76%) and no missed / residual stone was found. Rest of the patients were lost to follow-up.

**Table 4: Our complications**

- conversion in 4 patients (6%)
- minor bile leak in 2 patients (3%)
- wound infection in 3 patients (4%)
- ileus in 1 patient (1%)
- pancreatitis in 2 patients (3%)

**DISCUSSION**

The best treatment of choledocholithiasis must be simple, reliable, readily available, cost-effective and patient-friendly. The incidence of CBD stones in patients undergoing LC is 10-16%, so the surgeon must be prepared to manage CBD stones appropriately, depending on whether the diagnosis is made preoperatively or during the surgery. If choledocholithiasis is suspected preoperatively, recommendations in past were to get an ERCP and if stones were found, ES and extraction of stones.

But there are a few important variables to consider before committing ourselves to this so-called old testimony.

Firstly, ES is successful in >90% of the patients but it is highly dependent on the availability of an experienced endoscopist to achieve such a high success rate. The second consideration is that of cost and

the need for a second stage procedure. If a stent is placed then removal needs another endoscopy, usually after 4 weeks. The intervening period requires antibiotics in many cases which further increases the cost factor. Thirdly, there are no selective criteria that can accurately predict the presence of CBD stone. Taking into account all the positive predictors (history, clinical, biochemical, and sonography) for CBD stone, in most of the series reported in the literature, positive ERCP occurs in only up to 30-35% of the cases. On the other hand if we do routine IOC, we detect the stone in about 10% of cases and on selective IOC, CBD stones can be detected in about 25% of the cases.

Finally, the risk of potential complications of ERCP and ES should be considered. Although the complication rate is decreasing with increasing experience, pancreatitis continues to be a problem in most of the reported series, with an incidence of morbidity up to 7% and mortality of 0.2-2.3%. The Sphincter of Oddi (SOD) provides a barrier that prevents duodeno-biliary reflux and this function is permanently lost after sphincterotomy. ES increases duodenal reflux and a higher rate of bactibilia (60%) with the increasing rate of recurrent biliary stone formation.

This duodeno-biliary reflux further causes biliary epithelium to adapt to a new environment. Chronic bactibilia, in addition to pancreatic reflux (which is proved to be responsible for higher rates of malignancy in case of congenital choledochal cyst) may lead to neoplastic changes in the biliary epithelium.

LCBDE has considerable advantages for treating both gall bladder and bile duct stones in a single stage without any preoperative examination to detect the presence of stones in CBD. The main drawback of LCBDE is the increased operative time and the cost involved, particularly with the use of choledochoscope.

There is a possibility of false positive cholangiograms in open procedure but did not encounter this problem. LCBDE is successful in 75-95% of the patients and is comparable to the endoscopic treatment. Moreover, if the endoscopic treatment fails, particularly in the postoperative setting, this may require a third stage open procedure. While if LCBDE fails, one can convert at the same time. Also as the experience is increasing in LCBDE, the success rate will further improve.

Liebermann et al and Martin et al found that the single stage procedure had significant lower morbidity and shorter hospital stay resulting in lower cost than those of staged ES and LC.

In our study, patients who were unfit for operation or those with severe pancreatitis/cholangitis or with previous upper abdominal surgery or previous ERCP with CBD stone but bile duct dilatation <6 mm were subjected to ERCP and were excluded from the present study. We have deliberately not done ERCP in the study group patients considering the cost, two-stage procedure, risk of complications and the possibility of failure.

Our Institute being a centre for training in laparoscopic surgery also gave us the impetus to utilize LCBDE.

Certainly, ERCP has been an important modality for treating leftover CBD stone after LC. The current trends to utilize ERCP less, preoperatively, while expanding its role in the postoperative setting.

Various randomised controlled studies comparing the two-stage (ERCP with LC) procedure and one-stage LC with LCBDE showed that the one-stage procedure resulted in a shorter stay and similar stone clearance rates. Various complications of LCBDE reported in the literature are summarized in Table 5.

Transcystic CBD exploration is preferred as it is easy, more physiological, associated with less complication, does not require t-tube placement and intra-corporeal suturing and the post-operative course is almost similar to patients undergoing LC alone. However, a transcholedochal approach is a must if there are multiple stones (>5), stone >6 mm, proximal stone, CBD size <6 mm, cystic duct size <4 mm (too narrow to pass choledochoscope), and if there is any anatomical variation of the biliary tree.

**Table 5: Complications of LCBDE**  
**Overall complication rate after LCBDE is about 9.5%**

- conversion rate (5%)
- retained stones (<5%)
- biliary stricture (rare)
- bile leaks (<5%)
- intra-abdominal abscess
- pulmonary complications
- pancreatitis (rare)

Traditionally, CBD exploration is accompanied by t-tube drainage of CBD. Nevertheless, there are a few disadvantages: inconvenience and discomfort, delayed recovery, longer stay, risk of tube displacement, risk of infection and rarely, fracture of tube fragment retention in the CBD.

Lange et al first reported laparoscopic CBD primary closure with antegrade stent.[29] Recently, many studies have shown feasibility and potential advantages of antegrade stent which include decompression of CBD postoperatively, facilitation of ERCP cannulation postoperatively and early return to full activity.

Nowadays the combined laparo-endoscopic approach to CBD stone is talked about in which a modified plastic biliary stent is used (modified by breaking the proximal flange). Potential problems with the plastic stent are bile leak, stent occlusion, early stent migration and the need of future endoscopy for the removal of the stent.

In our study of 2900 patients undergoing LC, we performed IOC in 262 patients based on our selection criteria. Out of 262 patients we found CBD stones in 64 patients. We were able to successfully remove stones in 60 patients and in 4 patients, we had to convert to open CBD exploration as we were not able to remove completely all the stones laparoscopically.

Now we have every confidence in the technique of LCBDE, our success rate is 93% (4 conversions out of 64 explorations), there was no major complication, and in follow-up, no residual stone was found. Our operating time is also decreasing as all the team members are getting familiarised with the technique and equipments.

Although we still rely on ERCP and ES for high risk patients or those who are unfit for operation or those with severe pancreatitis/cholangitis or those who are diagnosed CBD stone with bile duct diameter <6 mm.

Our results are similar to the published data in the literature in terms of stone clearance, minimal complication, a shorter hospital stay, and rapid recovery time. The optimal management of choledocholithiasis remains unclear in the present laparoscopic era. Management at a single stage is the optimal approach in terms of safety, patient satisfaction and cost-effectiveness.

## CONCLUSION

CBD stones are associated with about 10-16% of the patients undergoing cholecystectomy. Treatment algorithms have changed for CBD stones with the advent of endoscopic management which is now getting further modified with the advancement in laparoscopic surgery. The treatment of CBD stones depends on the resources available, technical limitations and the surgeon's expertise. Laparoscopic CBD exploration is a safe, feasible and single-stage option for the management of CBD stones.

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